Topic: Focused science topics for Strategic Goal 2 (Sun-Climate): Solar Modulation of the galactic cosmic rays and the production of cosmogenic isotope archives of longterm solar activity, used to interpret past climate changes.

Project Title:
Physical Models of Cosmic Ray Response to Solar Inputs and their Effects on Cosmogenic Nuclei

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Project Information:
Cosmogenic nuclei, such as C-14 and B-10, archived in the environment, offer unique information on solar activity in the past when direct observations of the Sun were not recorded. Deciphering the data record requires a fundamental understanding of the various physical processes involved in producing the record and how these processes are related to the state of the Sun and hence to Earth's climate. The amount of cosmogenic isotopes deposited in ice cores or tree rings is determined by a number of complex processes: their creation depends on the cosmic rays flux at Earth, and on the geomagnetic field, while their deposition depends on atmospheric conditions.

We focus on a subset of this complex problem. First, we investigate how interstellar cosmic ray flux is attenuated in the heliosphere in response of solar activity. We propose comprehensive theoretical studies and numerical simulation work to improve our understanding of the physical relation between cosmic ray modulation and processes on the Sun. We aim to identify the major agents of solar input that drive cosmic ray modulation. We have a number of state-of-the-art 2-D and 3-D numerical codes of cosmic ray transport in the heliosphere. We shall improve our existing codes and develop new ones. The effects of the large scale organized magnetic field, the open magnetic flux, the strength of the magnetic field, as well as the effects of transient Global Merged Interaction Regions will be investigated and be related to processes on the Sun.

Second, we also propose to utilize new updated nuclear cross-section data for calculating the production rate of cosmogenic nuclei and test our results on available observational record in the past 70 years.

The proposed research would improve our ability to decipher cosmogenic records and understand their implication on the behavior of the Sun in the past.

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Citations: